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Conservation for Effective Management of AnGR in India

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Livestock sector forms an important livelihood activity for most of the farmers, supporting agriculture in the form of critical inputs, contributing to the health and nutrition of the household, supplementing incomes, offering employment opportunities, and finally being a dependable "bank on hooves" in times of need. India has vast Animal Genetic Resources (AnGR), which play a vital role in improving the socio-economic conditions of rural masses. AnGR is also of significant social and cultural importance, supplementing family incomes and generating gainful employment in the rural sector, particularly among the landless, small, marginal farmers and women. Global demand for livestock products is expected to double by 2050, mainly due to improvement in the worldwide standard of living. Meanwhile, extensive livestock production systems are being fast replaced with intensive and industrial production system due to change in land use, higher demand of livestock product and more and more keepers shifting to high producing improved breeds. The loss of a breed means the loss of a livelihood strategy and loss of indigenous knowledge. It also emphasizes the need for the active involvement of indigenous communities and the role of local knowledge and institutions in conservation.

Introduction

There are about 302.79 million bovines, 74.26 million sheep, 148.88 million goats and about 9.06 million pigs as per 20th Livestock Census in the country. Horses and Ponies, Mules, Donkeys and Camel population decreased by 45.6, 57.1, 61.23 and 37.1 percent, respectively, over previous Census. AnGR provide a range of products and services to their keepers and to the wider society – including food, fibre, transport and fuel. Most of AnGR are reared in extensive production system which contributes directly to food and livelihood security because they produce more valuable nutrients for humans, such as proteins, than they consume. AnGR rearing can contribute to farmer's risk management of natural calamities in many ways. They are mobile, which increases survivability and may also be relatively omnivorous, and thereby able to survive dramatic effects on specific feed resources. Indigenous AnGR keepers require very little resources as they are mostly very well adapted to the local environments and can survive on meager feed resources without any housing needs, Indigenous AnGR keepers are able to earn their livelihood by selling animal products like milk, egg, wool, etc. and also by selling the animals for meat purposes.

There are 202 registered breeds comprising 50 cattle, 19 buffalo, 44 sheep, 34 goat, 7 horse, 9 camel, 3 donkey, 10 pig, 19 chicken, 3 dog, 2 duck and one each of Yak and Geese. All these breeds have been developed over centuries by natural and manmade selection to meet the specific needs as per production systems and native environments. The defined breeds have become prominent during last two decades with various activities and effective awareness generation by ICAR-NBAGR. More and more populations in the country are now being characterized and registered as breeds. Proportion of non-descript animals in each species has declined significantly and purity within breeds is also increasing. Various State Animal Husbandry Departments (AHD) which are custodian of AnGR, are making effective strategies for conservation and improvement of their resources.

Attributes of indigenous animal genetic resources can be summarized as:

1. Large number of breeds in each farm animal species adapted to the specific agro-climatic conditions.
2. Diversified draft, milch and dual purpose cattle breeds. The draft breeds can significantly contribute in agricultural operations to save fossil fuels.
3. Adaptability of germplasm to diverse changing climatic conditions of hot arid, humid tropical and temperate climates and better resistance to parasites and diseases.
4. Capability to survive and produce on coarse and poor quality feed and fodder resources (low input).

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5. Availability of best breeds of buffaloes, a multipurpose farm animal species.
6. Large amount of ITK available with the livestock keepers for management of AnGR.
7. Seasonal migration of nomadic pastoralists help overcome adverse conditions especially during winter and rainy seasons which enable them to sustain the breed population maintained by them.

Conservation aims to maintain the option value of genetic diversity, it is therefore a priority of the Global Plan of Action for Animal Genetic Resources. Conservation measures for threatened breeds have already been established in some countries. Most current conservation programmes are based in developed countries with strong collaboration between gene banks and animal breeding organizations. In developing countries, the focus is typically on *in vivo* conservation. Realization that AnGR are at risk of being lost has alarmed the researchers and planners which stimulated National livestock conservation efforts. The need for conservation is based on economic, cultural, and ecological values; unique biological characteristics; shifts in market demand; and research needs. Livestock breeds are not biological taxa but rather represent the outcome of social processes and are therefore unlikely to survive outside the social contexts and production systems that formed them. Conservation of ecosystem/ production system guarantees breed survival.

Traditional pastoralists have often tended to foster biodiversity, in both plants and animals. Many pastoral societies have developed elaborate systems that result in the preservation of genetic resources. Pastoralists have deliberately developed livestock to meet different needs and conditions.

In the changing socio-economic scenario, it is becoming increasingly difficult to save local breeds specially those which are low producing. Major reasons are increased pressure on land to meet food requirement, the need for higher income per unit land/input to sustain better quality of life, shift of livestock activity from subsistence occupation to commercial entrepreneurship etc. The changing scenario calls for breeds with high performance to have higher profits. Sustaining low producing local breeds with poor economic viability is therefore really a challenge. Use of few specialized breeds with optimized specific production traits has lead to narrowing of the genetic base, as native breeds and species are neglected in response to market forces. Declining livestock diversity may have adverse affect on our capacity to mitigate the enormous challenges posed by climate change and emerging diseases. We may need to rely back on the adaptability and potential of indigenous animal genetic resources to face an uncertain future.

Commercial breeds of livestock possess greater genetic variability than most crop varieties do. This diversity allows intensification of selection within breeds to be a fruitful approach for improving livestock productivity. However, if continued emphasis on breed replacement and increasing selection intensity (e.g. for greater productivity) take place at the expense of maintenance of genetic diversity, including the advantages of disease resistance and environmental adaptation, there may be significant long-term costs. As an example, Holstein cattle have become the pre-eminent dairy breed world-wide and have enjoyed sustained improvements in milk production potential, but only at the cost of declining genetic diversity within the breed. These losses weaken the potential of breeding programs that could improve hardiness of livestock.

Indigenous breeds are considered hardy and well adapted to the environment. The hardiness of the indigenous breeds is believed to have resulted from natural selection under the management practices of the native breeders/herders and from the adverse feed conditions. Indigenous breeds show a high level of fertility and reproduction. *In situ* management of animal genetic resources can only be successfully accomplished through breeder actions.

Drivers of Genetic Erosion

Three factors are considered as being largely responsible for the declining genetic diversity of livestock:

- Destruction of the native habitats of livestock breeds;
- The development of genetically uniform livestock breeds;
- Farmer and/or consumer preferences for certain varieties and breeds (and changes in these consumer preferences over time);
- Climate change.

Among these, commercial interests are considered as the most important pressure on livestock diversity. Important factors in determining the direction and nature of change include: growth performance (productivity),

pest and disease resistance, ease of handling, adaptation to current levels of technology, and to a relatively minor extent consumer choice.

The characteristics of the indigenous breeds (low growth rate, lower level of production) imply that the potential for altering gross income is lower than more prevalent breeds under current marketing conditions. However, adaptation to the environment and reproductive performance may alter this situation. Short-term ownership negatively affects breed conservation by creating an unstable situation for maintaining or increasing animal numbers. However, it is doubtful that any effective selection will be implemented; therefore, the population may behave as if it is a randomly mated population, with minimal loss of alleles due to selection. With the relatively small total population size and small individual flock sizes, genetic drift is an important factor affecting within-breed genetic diversity. With the small flock/herd sizes, one should expect random gene frequency changes that are cumulative over generations.

Conservation infrastructure consists of a set of actions taken by the public sector for the public good. These actions include development of cryopreserved germplasm reserves that can be used to regenerate the breed, reduce inbreeding levels, and use molecular genetic tools to evaluate genetic diversity and/or genes of interest. A sufficient quantity of semen and, potentially, embryos should be collected to regenerate the breed if necessary and to relieve potentially high levels of inbreeding.

Breeds which are Facing Wxtinction

- Most of the draft cattle breeds like Krishna Valley, Nagori, Khilar, Bargur, Amritmahal, Punganur, Ponwar, etc.
- Many of the buffalo breeds like Bhadawari, Toda, Surti are facing threat as Murrah is being used as improver breed throughout the country due to increased demand of liquid milk.
- Due to very little value for the wool from the Indian breeds and scarce grazing resources most of sheep breeds are losing ground. Sheep are being maintained as meat animal but has to compete with goat which are more prolific and have an advantage over sheep for value of meat in large part of country.
- Most of the native breeds of chicken face extinction due to over emphasis on commercial chicken farming.
- The pack animal species like camel, equines, donkey, Yak etc. face threatened due to their very limited utility and changing production systems.

Conservation Methods

Conservation methods can be broadly categorized as *in situ* and *ex situ*. *In situ* conservation means that animals are kept within their production system. Important factor of *in situ* conservation cum genetic improvement is that selection should be carried out for its traditionally valued characteristics and in the environment to which it is adapted. The herds must be managed within the natural environment for that breed and need to be exposed to conditions prevalent in the field.

Ex situ conservation applies to situation where animals are kept outside their area of origin (herds kept in experimental farms, farm parks, within protected areas or in zoos) or more often, when genetic material is conserved and stored in gene banks in the form of semen, ova, embryo or DNA. Conservation through any of these methods has its own merits and demerits.

1. **Organized flocks/herds:** Maintenance of small population at a place away from the main breeding tract of the breed is the *ex situ* conservation of the live animals. This may be in the form of organized herd maintained in a research institution, bull mother farm, state owned livestock farm, zoo or breed park. This population can be used in regeneration of endangered breed and new breed development.
2. **Cryopreservation of embryos:** This is ideal for breed improvement, conservation and revival of lost breed. Its main importance is due to its diploid nature and containing all genes. However conserving embryos finds limited use, as its production and transfer require highly skilled manpower and large resources.
3. **Somatic cell banking**: Somatic cells can be used as genetic material to restore precious germplasm if the need so arises thus Fibroblast bank offers a practical approach to preserving the germplasm. However, cryobanking of somatic cells has been an underutilized tool in the national livestock conservation program. Skin fibroblast cells are selected for long-term preservation due to their easy accessibility, non-invasiveness, and any limitations on the sex or age of the animal.

4. **Epididymal sperms banking:** Epididymal spermatozoa particularly caudal spermatozoa are mature and have full competence to undergo normal fertilization and cause fetal development. *In vitro* fertilization (IVF) experiments have revealed that epididymal semen possesses binding sites for important zona pellucida proteins. Collection of cauda epididymal semen from slaughtered animals would be a rapid and cheap alternative of sperms conservation as it would obviate the requirement of time consuming and extensive training of males for semen donation.
5. **Cryopreservation of embryonic stem cell lines**: This can be excellent biological material for producing live animals and producing genetically modified animals. This also finds usage in gene and cell therapies, and for producing vital therapeutic proteins.
6. **Cryopreservation of spermatogonial stem cell lines**: Transplantation of spermatogonial stem cells (SSC) from a donor testis into the seminiferous tubules of a recipient testis results in donor-derived spermatogenesis. SSCs transplantation has been demonstrated in goats, dog, cow, pig, baboon and bovine spermatogonial stem cells shown to be capable of colonizing recipient mouse seminiferous tubules. An *in vitro* system that supports the proliferation and maintenance of SSC could be used to preserve and expand SSC numbers as well as aid in genetic modification.
7. **Storage of DNA**: Cryogenic storage of DNA has several advantages over the live germplasm as it is very easy to obtain, store, transport at low cost with no chance of disease transfer. DNA may find use in gene conservation through their introgression by transgenesis or knock out technology, and can help in recreation of lost breeds by cross checking of different populations or genetic material used.
8. **Frozen Semen**: This is an ideal and most common for genetic resource utilization activities, providing sample half of the genetic material of preserved breeds in a form that permits convenient introgression into recipient population. Availability of established semen freezing technology and presence of semen freezing infrastructure across the country makes it method of choice for conserving indigenous livestock biodiversity. ICAR- National Bureau of Animal Genetic Resources (NBAGR) is playing a pivotal role in *ex situ* conservation through semen, somatic cell and DNA cryostorage of indigenous livestock for posterity by establishing a National Gene Bank at Karnal.

Future Prospective and Action Points

Genetic diversity defines not only animal breeds' production and functional traits, but also the ability to adapt to different environments, including food and water availability, climate, pests and diseases.

Diverse animal genetic resources are a key to economic development. Many local livestock breeds continue to represent the lifeline of rural populations. The diversity of these resources makes possible human livelihoods in some of the most inhospitable areas where crop production cannot be exclusively depended upon. While they may not be able to compete with "improved breeds" in milk and meat yields, they fulfill a much wider range of functions and provide a larger range of products. Being able to thrive even with low fodder inputs, their maintenance is ecologically more sustainable, especially in marginal environments. Requiring lower levels of health care and management, they commonly entail a lower workload in comparison with exotic breeds. As is becoming increasingly clear, they often have scope for specialty products and can be essential to preserve habitats and cultures.

Given the above conditions, there are two areas in which to base conservation efforts. These consist of developing a conservation infrastructure (a public service) and breeder actions (a private-sector activity).

Nongovernmental organizations have to play a key role in the conservation of indigenous breeds, and their engagement is likely to continue by assisting breeders with technology transfer.